112 Haokea Drive
Kailua, HI 96734
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Donna Wieting,
Chief,
Marine Mammal Conservation Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910-3226

Dear Ms. Wieting:

I will try to state briefly my objections to the proposed "take" of marine mammals in consequence of the new SURTASS LFA sonar, hereinafter referred to simply as LFA.

As my objections are technical I should perhaps begin by noting that I happen to be a professional researcher in the fields of wave propagation, signal processing and underwater sound. My research has been published in peer-reviewed journals sucha as *GEOPHYSICS, Journal of the Acoustical Society of America,* and *Geophysical Journal International.* My research has been supported by the Office of Naval Research, the National Science Foundation, and the Petroleum Research Foundation.

My main objection to LFA is its source level. I do not believe that a source level of 215 dB is necessary or even desirable. There are more elegant, more effective approaches to the detection problem that do not require such high source levels. Let me outline just three: (a) longer duration source signals; (b) more sophisticated arrays; (c) synthetic multi-ship arrays. All three of these techniques can be used together to increase the signal to noise ratio of echoes from submarines.

Technique (a) is analogous to the Vibroseis technique of exploration seismology whereby a long weak signal from a vibrator truck replaces a short sharp signal from dynamite. After decorrelation the echoes are the same as those that would have been recorded from the much louder dynamite source. Use of long pseudo-random source signals gives even better results.

Technique (b) would involve replacing the current Navy single towed array technology by the multiple towed array technology well known in marine exploration seismology. The multiple towed arrays I have in mind would be similar to those used in seismic exploration except that they would be towed at different depths, and would therefore be beamed horizontally, instead of vertically, in order to look for submarines.

In technique (c) arrays are towed simultaneousl by several ships, and the signals from the different arrays are exchanged by radio and beamformed on all three ships. This gives an effective array with a very wide aperture. Just as important, the multi-ship array is robust with respect to enemy action since the signal processing on all three ships means that if one ship is lost the only effect is somewhat reduced resolution. By contrast, the single-ship scheme now proposed by the Navy is broken if the single ship is disabled by an attack. In the multi-ship scheme radio jamming is not a problem if spread spectrum technology is used for inter-ship transmission of array signals.

In an obvious extension of techniqe (c) any number of unmanned, remotely-operated surface vessels would tow arrays and radio their signals to manned surface ships.

In summary, I would say that the LFA, as proposed, indicates a lamentable lack of creative thinking in Naval technology. What they are proposing is a technological dinosaur. We would be doing them a big favor by forcing them back to the drawing board.

Sincerely,

L. Neil Frazer, PhD.